PROSPECTIVE ARTIFICIAL AQUIFER RECHARGE PROJECT, HANOVER COUNTY, VIRGINIA

EASTERN VIRGINIA GROUNDWATER ADVISORY COMMITTEE
WORKGROUP #1

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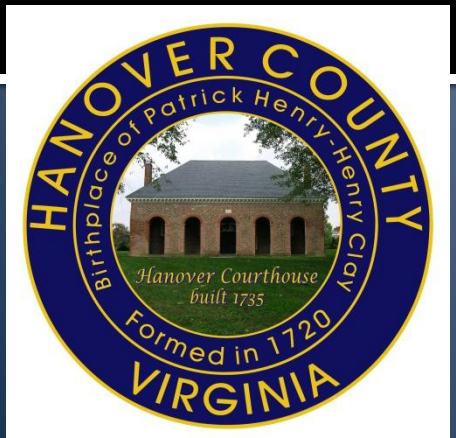

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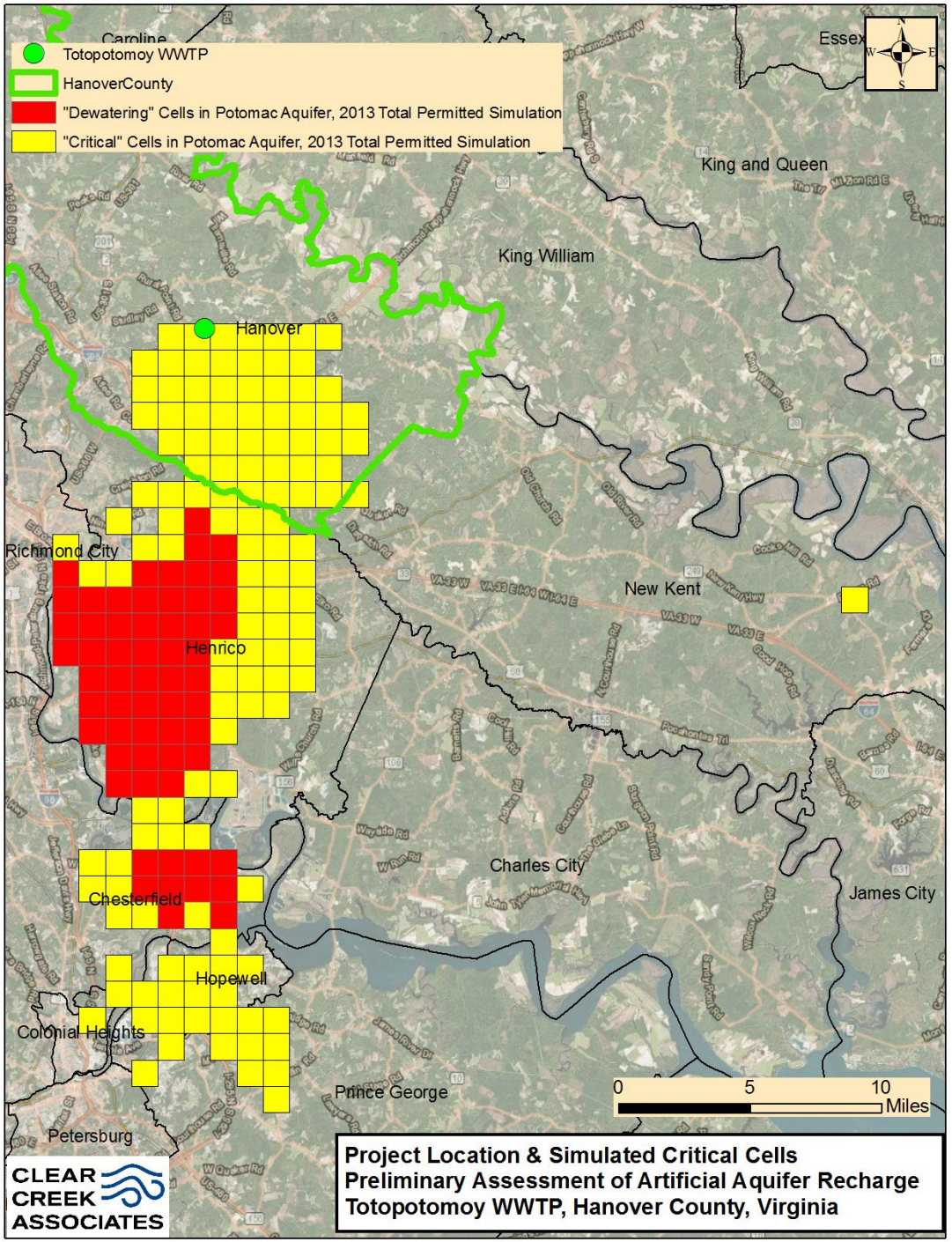
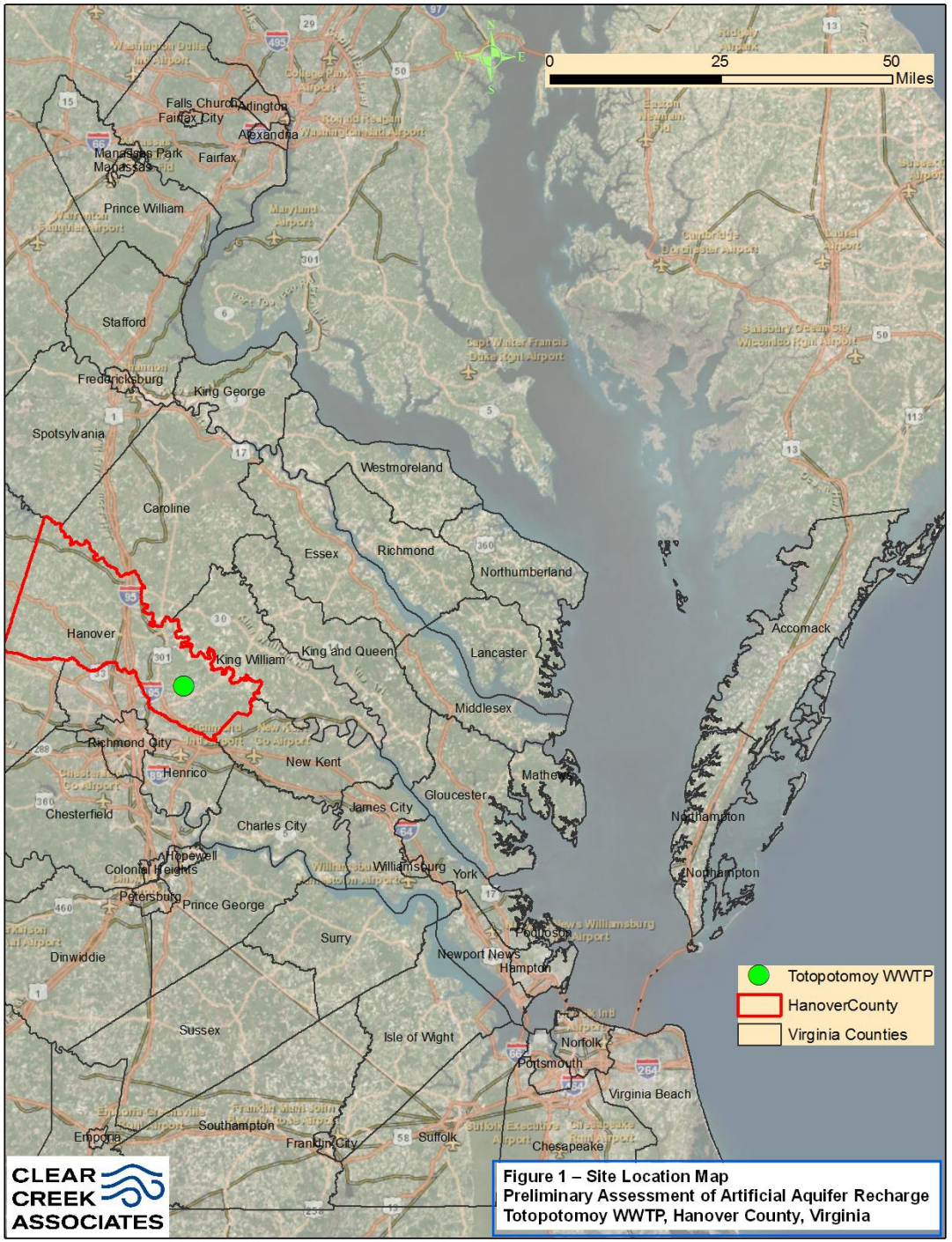
Intro - Project

Location & Critical Cells



Intro - Project Location



Agenda

- Introduction & Objectives
- AR Basics & Conceptual Benefits
- Reasons for Considering AR
- Well Search Inventory
- Model Simulations of Potential Benefits
- Regulatory / Permitting Process Review
- Chesapeake ASR File Review (example)
- Path Toward Assessment of Feasibility & Permitting
- Other Critical Questions

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Introduction & Objectives

- Hanover County contracted Clear Creek Associates to conduct a preliminary study of artificial aquifer recharge (AR) at the Totopotomoy WWTP
- The prospective AR project would inject treated wastewater from the WWTP into the Potomac aquifer
- Study Objectives:
  - Simulate potential benefits to local aquifer system of an AR project at the Totopotomoy WWTP
  - Identify GW users and well owners located near the AR site
  - Identify and summarize EPA and DEQ regulations and permit requirements associated with implementing the prospective AR project

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Artificial Recharge Basics

- Artificial aquifer recharge (AR) is the enhancement of natural ground water supplies using man-made conveyances such as infiltration basins or injection wells.
- Water sources can include:
  - Surface water
  - Treated waste water
- Where is AR being conducted?
  - Southwest US, CA, OR, NJ, PA, DE, FL, GA.
  - Chesapeake, Virginia ASR (since ~1990s/2000s)

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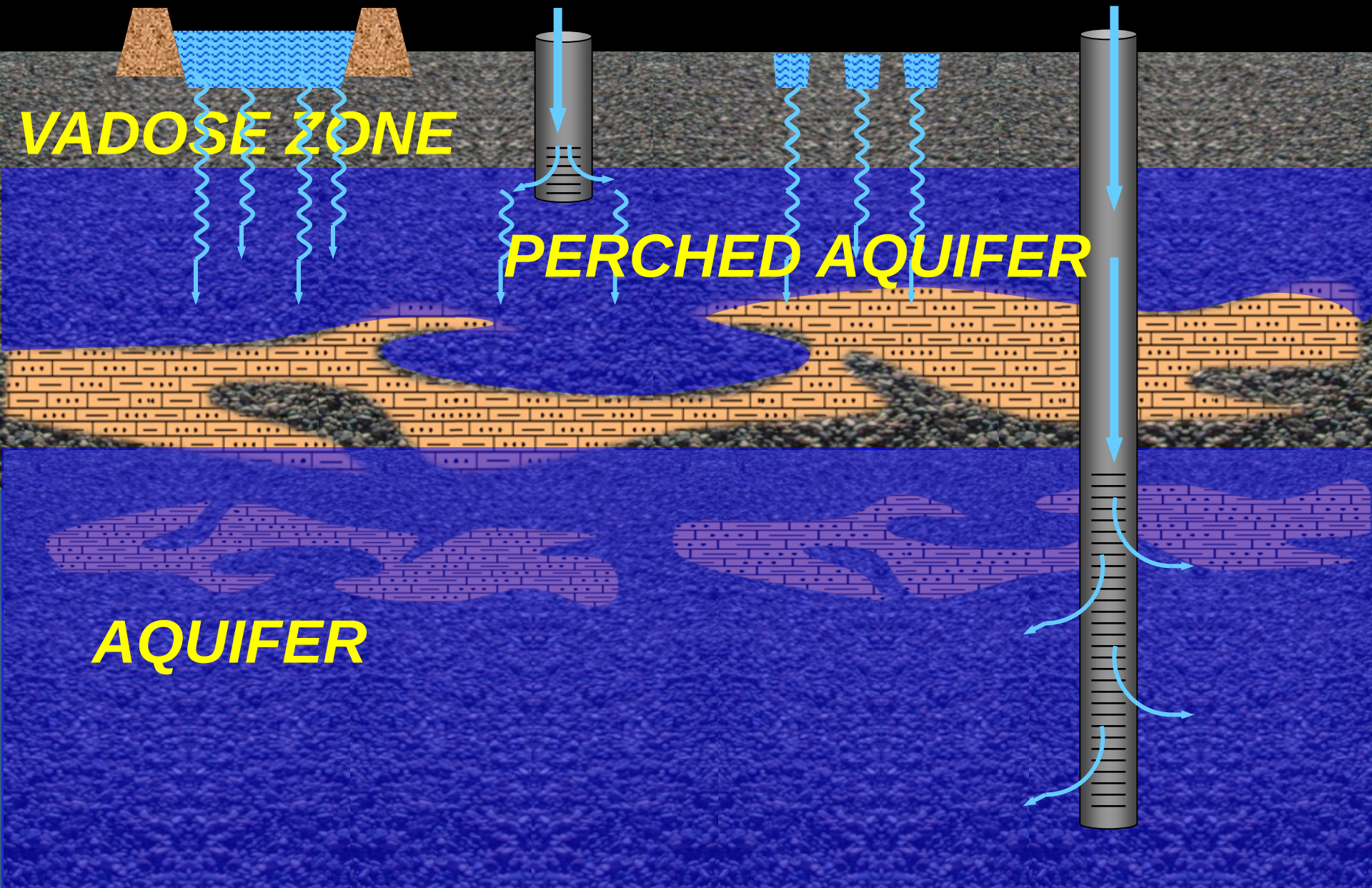
Primary Recharge Methods



Conceptual Benefits of AR

- Stabilize/reverse WL declines in overdrawn aquifers
  - Continued WL declines increase power consumption & pumping costs
  - Well owners may need to deepen existing wells and/or lower pump intakes
  - Limit GW available for future consumers and community/economic growth
- Reduce nutrient loading on surface water bodies
  - Nutrient discharges from the WWTP managed under the TMDL program
  - Injection of treated WW would reduce mass of nutrients discharged, potentially translating into treatment cost savings and helping the overall Bay cleanup effort
- Support continued development/land-use alternatives for eastern Hanover County
  - Stakeholders could be assured of continued access to the GW resource

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Reasons for Considering AR

- In western Coastal Plain (including Hanover Co.), modeling and WL data suggest that Potomac and other aquifers could reach a "critical" state or even begin to "dewater" within the next 50 years or less
- Deepest, thickest, and most heavily-used aquifer is the Potomac, which underlies ~eastern ½ of Hanover County and represents a potential water source for future development
- GW in deep aquifers naturally recharges very slowly (>1,000 years), so recent reductions in withdrawals alone will not restore GW levels
- AR is one of many options being considered to help stabilize and restore GW levels in the aquifers of the VA Coastal Plain

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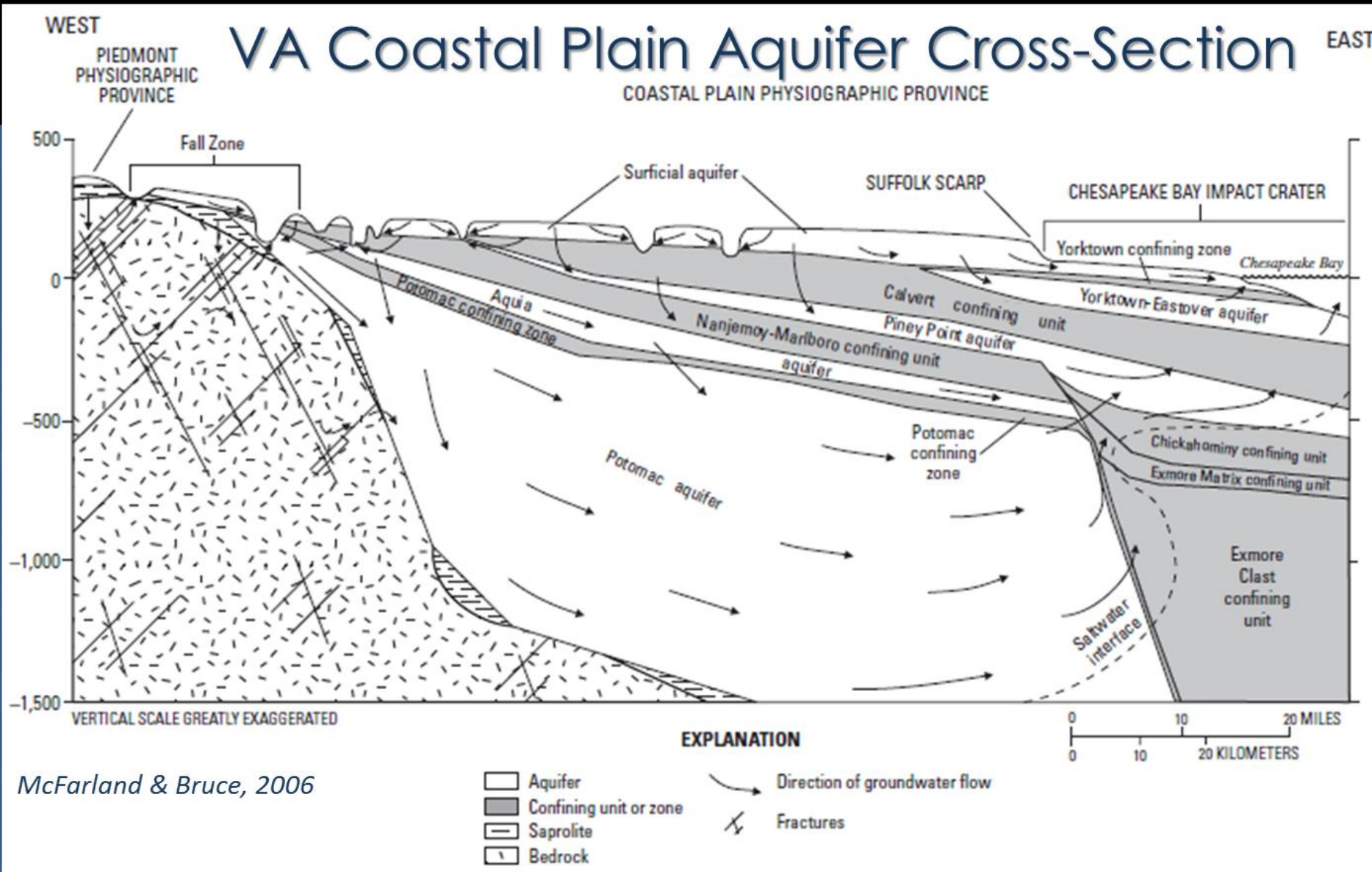
VA Coastal Plain Aquifer Cross-Section



McFarland & Bruce, 2006

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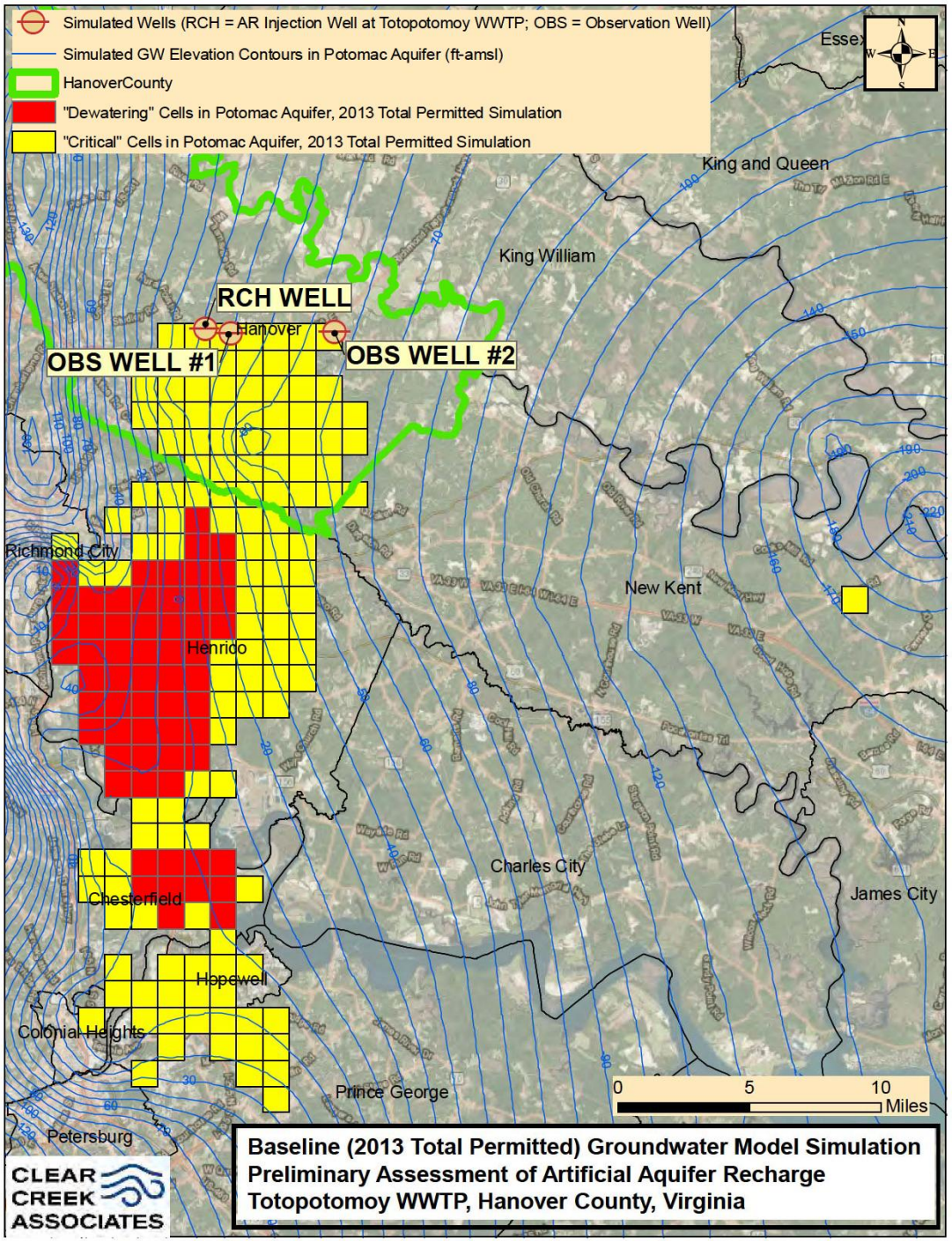
Reasons for Considering AR

- "Critical" cell = where the WL >= 80% of depth to top of aquifer
- "Dewatering" cell = where the WL > top of aquifer
- "Current" (2013 total-permitted) simulation predicts 865 mi² of critical cells and 374 mi² of dewatering cells



Well Search Inventory

- 1-mile search radius (SWAP Zone 2)
- One public well just outside 1-mile radius
- 348 parcels within 1-mile area
- Hanover HD has files on 98, with well logs for ~ 1/2
- Most properties not connected to public water and presumed to rely on private wells

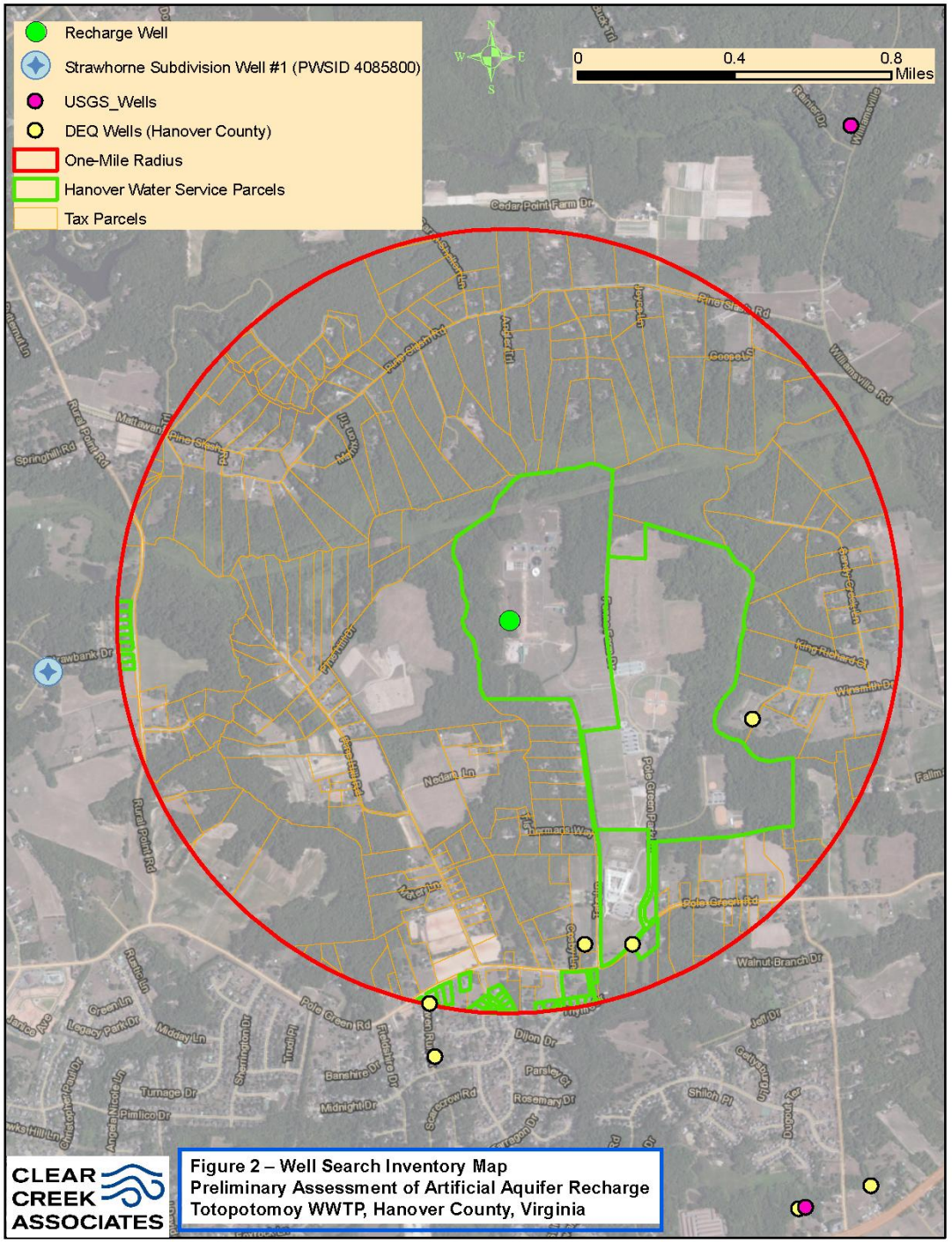
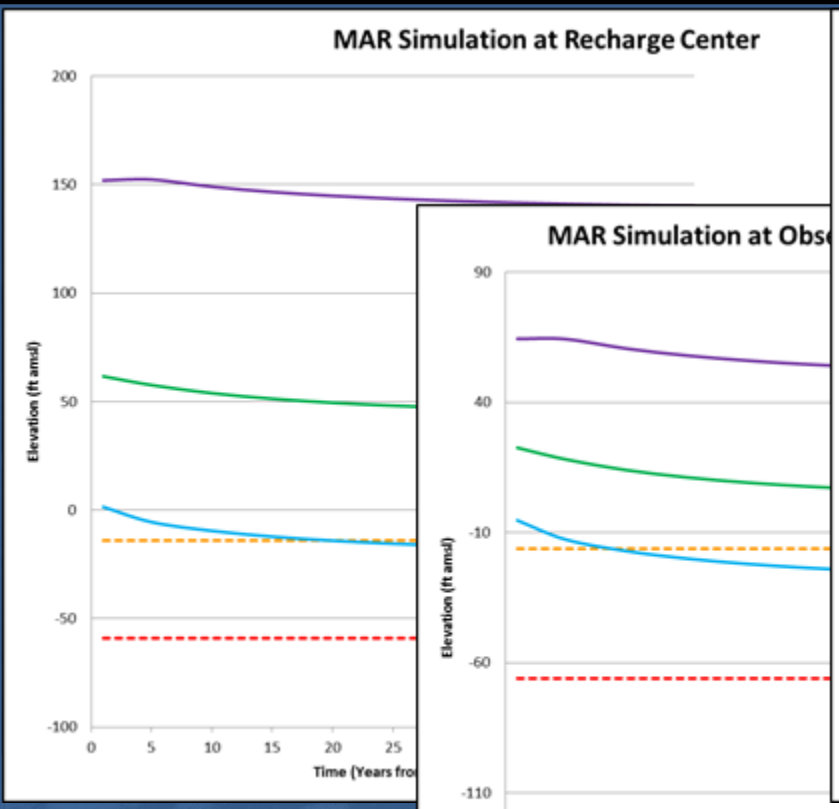
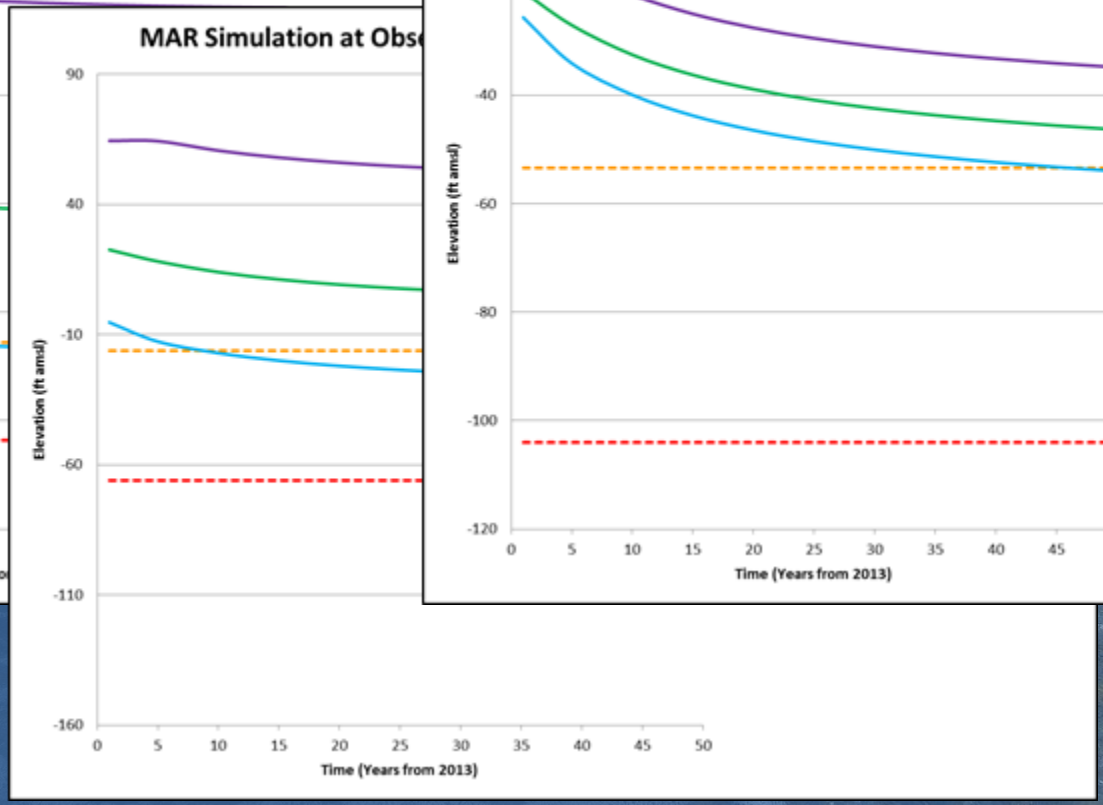
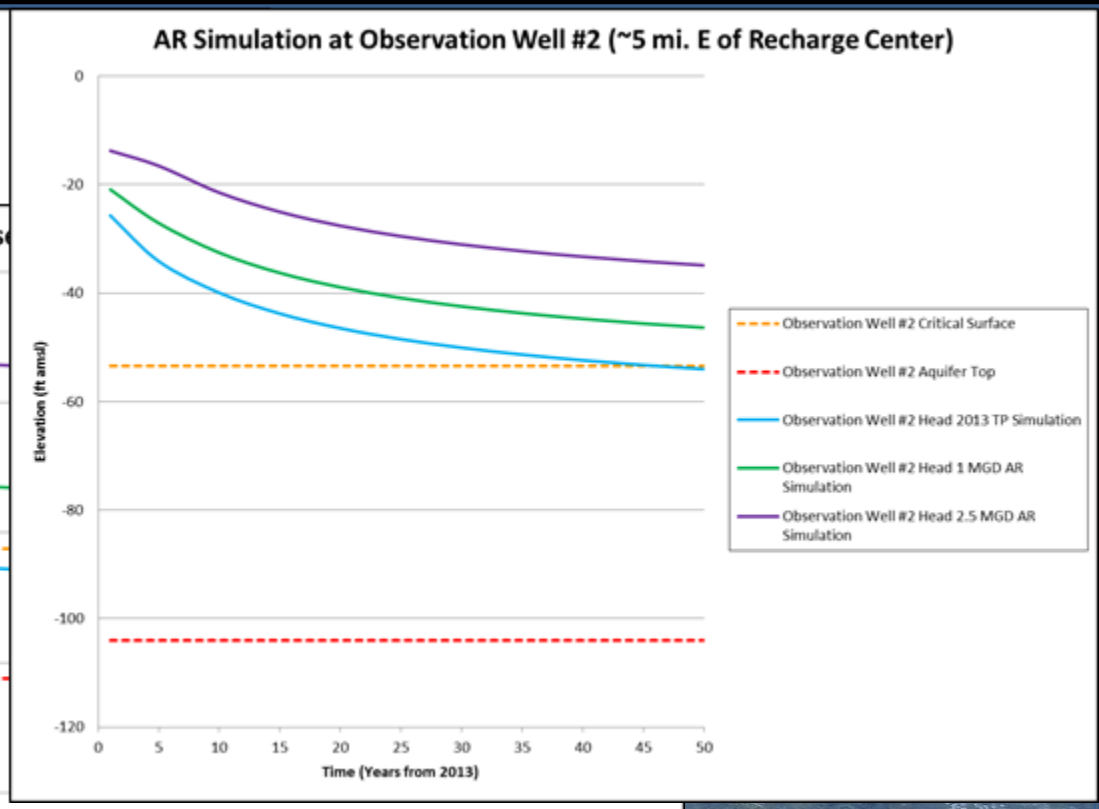


Figure 2 – Well Search Inventory Map
Preliminary Assessment of Artificial Aquifer Recharge
Totopotomoy WWTP, Hanover County, Virginia

Model Simulations– Restoration of Water Levels







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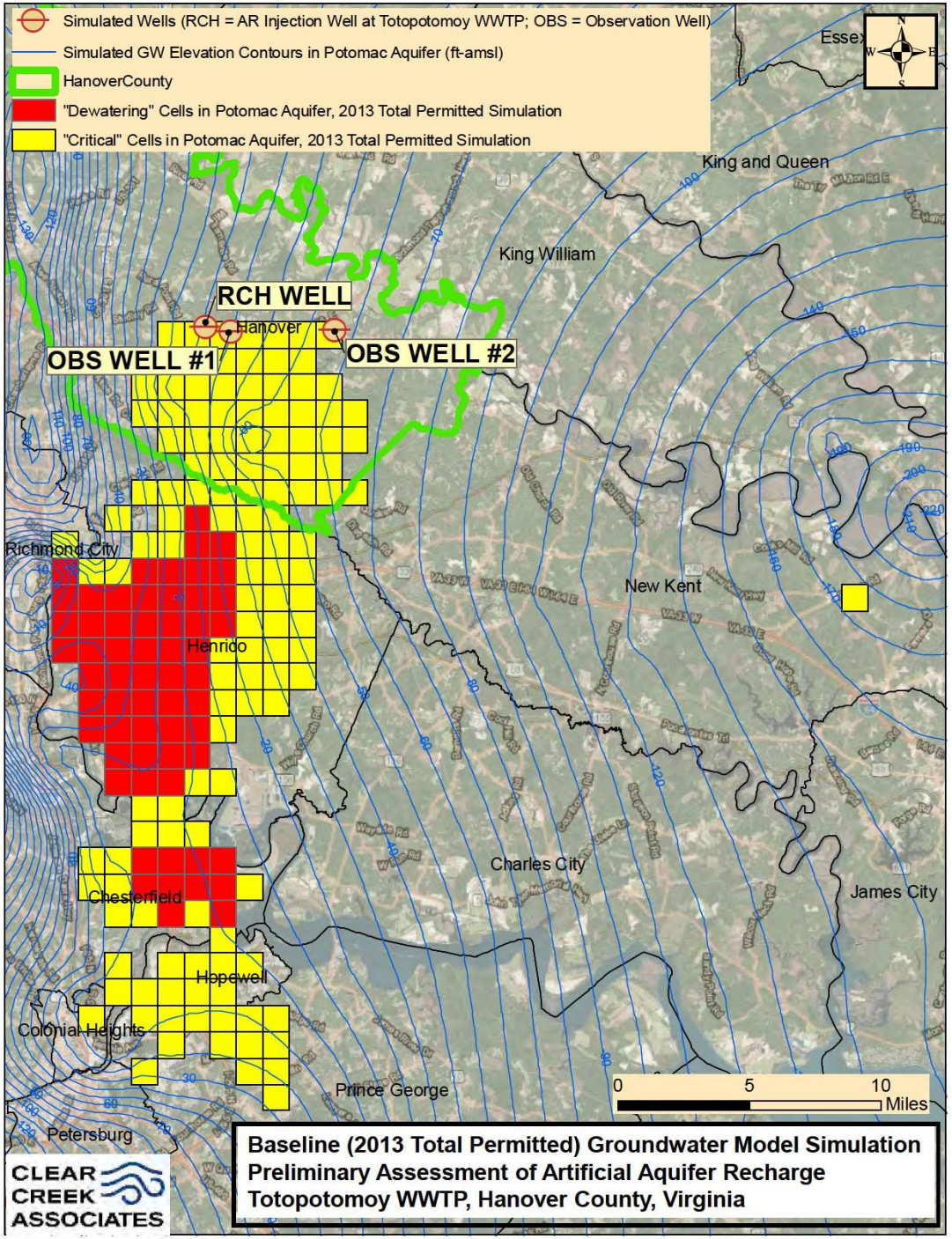
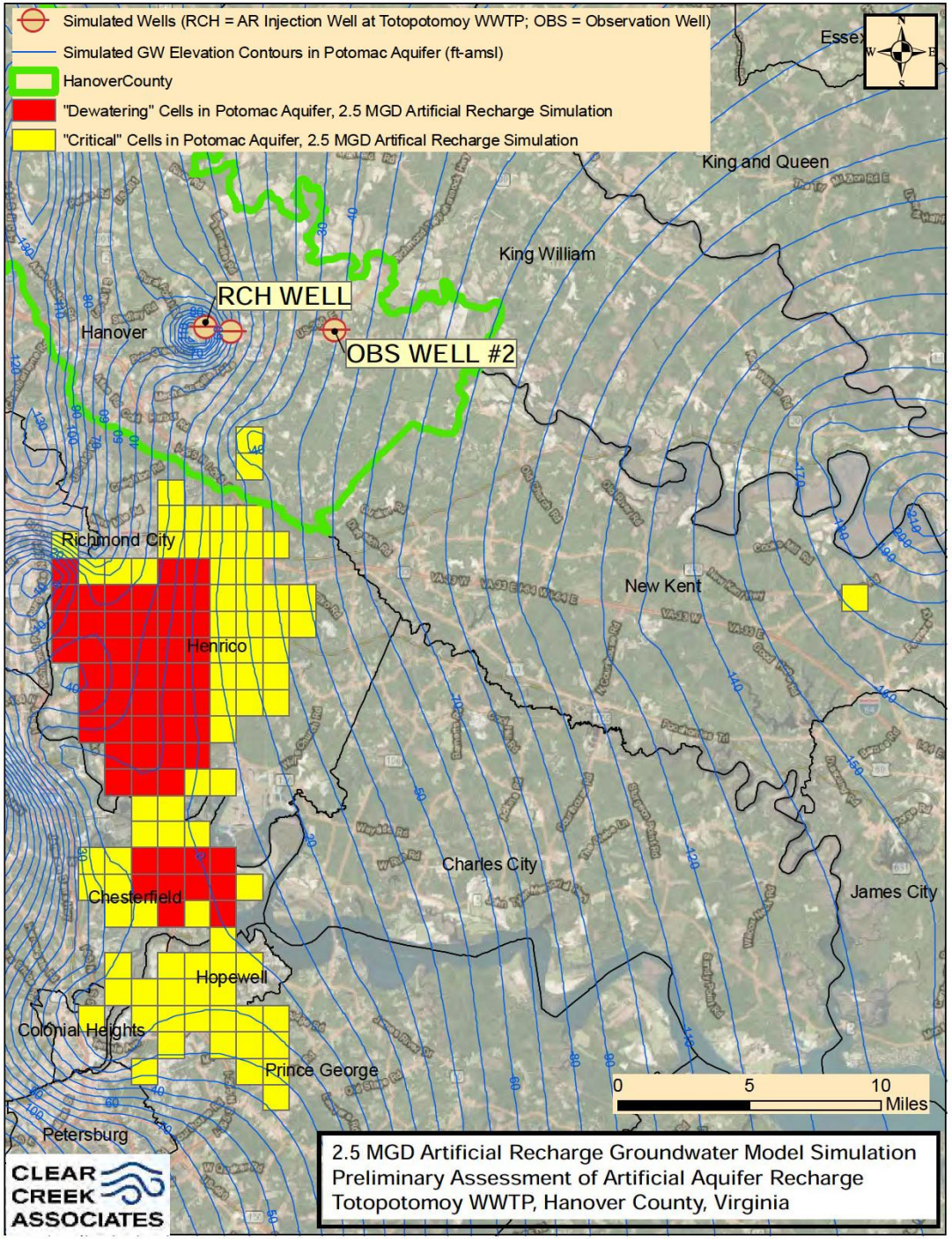
Baseline Simulation – No AR

- 865 mi² of total critical area
- 49.3 mi² of critical area in Hanover County



2.5 MGD AR Simulation – Reductions in Critical Areas

- 800 mi² of total critical area:
  - 65 mi² reduction
- 2 mi² in Hanover County:
  - 47.3 mi² reduction



Regulatory / Permitting Process Review

1. Reviewed EPA Underground Injection Control (UIC) program regulations (40CFR, Subchapter D, Part 144)
2. Held conference call with EPA Region III UIC Coordinator
3. Met with DEQ Groundwater Withdrawal Permit (GWWP) program staff

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EPA / UIC Requirements

- UIC is a preventative program focused on protecting underground sources of drinking water (USDWs)
- Prospective AR project would use "shallow" Class V injection well(s), those that inject directly into or above USDWs
- EPA would require a demonstration of water quality per Safe Drinking Water Act (SDWA):
  - Compare treated WW effluent quality to primary & secondary DW standards (MCLs)
  - Focus on common municipal WW constituents (microbes and nitrate)
- EPA has authority to require a permit (including public participation requirements), BUT has not and does not plan to issue individual permits for Class V UIC wells
- If the requirements of the UIC program and SDWA provisions are met, EPA would issue a notice to Hanover County that the AR project is *authorized-by-rule*

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DEQ / GWWP Requirements

- Currently no specific permit process in VA for AR projects, but DEQ's preliminary interpretation: such a project could be reviewed and authorized via GWWP process (9VAC25-610-10 *et seq*.)
  - Application requirements similar to standard GWWP for GW withdrawal, such as demonstration of benefits and a modeling evaluation to delineate area-of-impact and potentially-affected properties for the mitigation plan (e.g., City of Chesapeake ASR project)
- WQ and WL monitoring, establishment of point-of-compliance, and mitigation plan would likely be required by DEQ
- AR project could be added to an existing GWWP, and the withdrawal and injection volumes need not balance
- An injection pilot test (recommended for full-scale system design), could be authorized by DEQ via Special Exception (9VAC25-610-170), allowing for site-specific feasibility testing prior to full permitting process including public comment

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Chesapeake ASR Project File Review (example)

- ASR = aquifer storage & recovery
  - Type of AR
  - Water is stored in aquifer short-term, to be withdrawn later
  - Different than long-term AR being considered to mitigate GW overdraft issues in VA, but mechanics and permitting process are similar
- 1st AR project in VA & 1st in EPA Region III
- ASR intended to help manage chloride levels in DW system
- Source of injection water = treated surplus DW
- Project consists of ~7 withdrawal wells, 1 ASR well (injection & withdrawal), & 12 MWs in Potomac aquifer

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Chesapeake ASR Project File Review (example)

- EPA issued a Class V UIC permit for this ASR project, but later re-authorized by-rule
- DEQ authorized the project as part of the City's GWWP, with special requirements for monitoring of WLs and GW quality, a modeling evaluation, & a mitigation plan
- DEQ initially required a VPDES permit for injections into the ASR well but later determined to be excluded from VPDES
- Relatively short-term injections did not create a long-term increase in WLs due to larger and longer-term withdrawals from extraction wells, **BUT**
- **ASR project provided the City of Chesapeake a valuable WQ management tool & was authorized through existing EPA and DEQ permitting programs**

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Chesapeake ASR Project File Review (example)

- Project design included:
  - Permitting requirements
  - Borehole geophysical and test corehole logging
  - Bench-scale permeability testing
  - Aquifer testing
  - GW flow modeling
  - Geochemical/mixing analysis to evaluate potential impacts to GW & aquifer chemistry
  - Pilot-scale injection testing with WL and WQ monitoring

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Path Toward Assessment of Feasibility & Permitting

- Based on results of regulatory/permitting review and our experience scoping, planning and implementing AR projects, Clear Creek prepared an outline for preliminary planning purposes
- Other tasks, not included in outline, that would likely be required prior to implementation of an AR project (e.g., public involvement)

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Path Toward Assessment of Feasibility & Permitting

Preliminary Planning & Scoping

A. Scoping Analysis & Preliminary Planning
B. Pre-Application/Notification Meetings with DEQ and EPA

Hydrogeologic Characterization

A. Work Plan for Hydrogeologic Characterization & Baseline Monitoring
    a. Define geology, aquifer properties, and injection test feasibility
    b. Obtain Work Plan approval from DEQ
B. Implement Hydrogeologic Characterization & Baseline Monitoring, e.g.:
    a. Exploratory test borings & monitoring well installation
    b. Baseline water quality sampling
    c. Water quality blending analysis of treated water and aquifer water
C. Prepare and submit Hydrogeologic Characterization Report to DEQ
D. Prepare and submit Water Quality Demonstration Report to EPA

Pilot Testing

A. Design AR Injection Pilot Test and Prepare Pilot Testing Plan
B. Prepare and submit UIC Notification to EPA for Pilot Test
C. Prepare and submit Special Exception Permit Application to DEQ for Pilot Test
D. Receive EPA Authorization and DEQ Special Exception Permit
E. Implement Injection Pilot Testing Plan
F. Prepare and submit Pilot Testing Report to EPA and DEQ

Full-Scale Design & Implementation

A. Design Full-Scale AR Project
B. Prepare and submit UIC Notification to EPA for Full-Scale AR Project
C. Prepare and submit GWWP to DEQ for Full-Scale AR Project
D. Receive Authorizations and Implement Project

Other Critical Questions

- Other permitting/regulatory review requirements?
- Technical feasibility? For example,
  - Can aquifer accept injections at desired rates?
  - Can WW be treated to meet UIC/SDWA requirements?
- Capital and long-term O&M costs?
- Public/community acceptance?
- Opportunities for public/private & regional partnerships?

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